

REMARKS

This application has been carefully reviewed in light of the Examiner's Action dated September 26, 2006. Claims 1, 2 and 64 have been amended, and Claims 21 and 22 have been cancelled without prejudice. New Claims 67 and 68 have been added to more fully claim certain aspects of the invention. Reconsideration and full allowance are respectfully requested.

Initially, the Examiner has noted that an amended listing of the Claims was not presented in connection with the Election Without Traverse. A complete listing of the Claims is provided herewith.

The Examiner also required new formal drawings, and new formal drawings are also being submitted herewith.

Claim 15 was objected to because of a typographical error and has been amended above to address the error. In addition, Claims 2-12 were rejected under 35 U.S.C. § 112 due to lack of antecedent basis. Claim 2 has been amended to address this rejection.

The Examiner rejected Claims 1, 17-18, 21 and 64 under 35 U.S.C. § 102(b) as being unpatentable over U.S. Patent No. 3,967,347 by Segre, et al ("Segre"). This rejection is respectfully traversed for the reasons set forth below.

As presented, Independent Claim 1 is directed to an optically efficient, high pulse energy lidar system. In particular, the lidar system has a receiver field of view at least as great as the divergence of the laser beam. This provides enhanced optical efficiency as the receiver can "see" substantially the full volume of atmosphere illuminated by the source in the coaxial transmit/receiver system geometry. Moreover, the transmitted beam has a pulse repetition frequency of at least about 10 Hz and a pulse energy of at least about 100 mJ/pulse. This supports certain applications including imaging of aerosol plumes or other aerosol structure in the atmosphere.

Imaging of aerosol plumes is a particularly challenging lidar application. First, unlike detecting clouds or precipitation, the aerosol structures of interest are difficult to detect, and it is desired to detect such aerosol particles even when they are present only in low concentrations. For example, one application of the invention is to detect biological agents in the atmosphere. Accordingly, it is desirable to transmit a beam of significant energy and/or to detect even low levels of backscattered radiation. Moreover, unlike detecting cloud ceiling levels, in various applications supported by the claimed invention including aerosol detection/evaluation, it is desirable to image a significant volume of the atmosphere by scanning the lidar beam across the volume to be imaged. In

order to obtain meaningful information, the scan should be completed in a reasonably short period of time in relation to anticipated rates of movement of the aerosols in the atmosphere. In this regard, Applicant is attaching an article showing (at pg. 173) an image acquired by a system, according to the present invention, deployed near the Pentagon. It should be appreciated that, while a still image is shown for print purposes, the system yields full motion video images.

It will thus be appreciated that significant energy is transmitted into the atmosphere and detected in such contexts to collect adequate backscattered radiation and that such energy levels are transmitted in short time frames (i.e., a single pulse or small number of pulses at a suitable pulse repetition frequency) to enable scanning rates for effective imaging. That is, high levels of both spatial and temporal resolution are desired. Yet, this is preferably accomplished at eye safe levels to avoid harming pilots, passengers, building occupants and the like. Corresponding subject matter is set forth in Independent Claim 1, which recites limitations related to wavelength, optical efficiency, pulse repetition frequency and pulse energy.

The Examiner rejected Claim 1 as being anticipated by U.S. Patent No. 3,963,347 by Segre, et al ("Segre"), which is directed to a ceilometer. The Segre ceilometer application does not involve imaging, much less levels of spatial and temporal resolution as discussed above. It is therefore unsurprising that Segre does not disclose or suggest the subject matter of Claim 1 as presented. For example, Segre, which is not concerned with scanning for producing an image, does not disclose a suitable combination of wavelength, optical efficiency, pulse energy and pulse repetition frequency.

In this regard, the Examiner cites Col. 2, lines 54-57 as disclosing a lidar system with a pulse energy of 100 mJ/pulse. Applicant respectfully submits that the cited passage does not provide such disclosure. First, the cited passage is not describing the Segre system but is a background discussion concerning how eye damage is wavelength dependent. In context, the cited passage recites:

However, in the region between 1.4 and 1.6 microns, no retinal eye damage occurs at radiation levels below 1 joule/cm². With erbium lasers operated in the 100 millijoule range, no damage is experienced by the human eye even by direct irradiation at close range. This is contrasted to the ruby laser which, at 100 millijoules would cause considerable damage upon direct irradiation of the human eye.

Thus, the recited parameters are not set forth as operating parameters of the Segre system.

In any event, the cited parameter is not 100 mJ/pulse. Rather, Applicant submits that the cited parameter is an intensity parameter. Again, the cited passage is presented below in context.

While other damage, such as the damage to the cornea, does not occur with an intensity below about 0.5 j./cm^2 , retinal damage may begin to occur at an intensity of 10^{-7} j./cm^2 at the cornea or, correspondingly, 0.7 j./cm^2 on the retina. However, in the region between 1.4 and 1.6 microns, no retinal eye damage occurs at radiation levels below 1 joule/cm^2 . With erbium lasers operated in the 100 millijoule range, no damage is experienced by the human eye even by direct irradiation at close range. (emphasis added)

Applicant submits that this discussion relates to intensity, said to be measured in energy (joules) per area (cm^2), and does not indicate any time dimension, e.g., per pulse as claimed. Accordingly, Segre, even in the context of this background discussion, does not discuss a 100 mJ/pulse parameter.

For all of the foregoing reasons, Applicant respectfully submits that Segre does not disclose the claimed subject matter including the noted limitations related to wavelength, optical efficiency, pulse repetition frequency and pulse energy. Accordingly, Applicant submits that Independent Claim 1 and its dependent claims are patentable over Segre and this rejection should be withdrawn.

Independent Claim 64 is directed to a method for analyzing atmospheric aerosols that involves transmitting a beam with a high pulse energy. Specifically, the method involves transmitting a beam into the atmosphere and receiving backscatter radiation of the beam. The beam has a wavelength between about 1.5 – 1.8 microns and a pulse energy of at least about 100 mJ/pulse. Moreover, the field of view of the receiver is at least about equal to the divergence of the transmitted beam. Accordingly, the Claim sets forth limitations related to wavelength, optical efficiency and pulse energy. As set forth above, the method of the present invention enables detection of atmospheric aerosols, which is a particularly challenging lidar application and, specifically, allows for imaging of aerosol structures such as by scanning of the lidar beam.

As discussed above, Segre is directed to a system for measuring a cloud ceiling. Segre is not concerned with imaging of aerosol or other structures in the atmosphere and does not disclose operation suitable for scanning the atmosphere to produce such images. As discussed above, Segre does not disclose the 100 mJ/pulse parameter. Application therefore respectfully submits that Independent Claim 64 is patentable over Segre and this rejection should be withdrawn.

The Examiner rejected Claims 13-15 under 35 U.S.C. § 103(a) as being unpatentable over Segre in view of a publication by Cheng, et al (“Cheng”). As discussed above, Claim 1 includes a transmitter for transmitting an optical beam having a pulse repetition frequency of at least about 10

Hz and a pulse energy of at least about 100 mJ/pulse. Segre does not disclose the subject matter of Claim 1 for the reasons noted above. Cheng does not supply the subject matter lacked by Segre. In particular, Cheng is directed to a micropulse lidar system. It involves lidar beams with pulses in the microjoule energy range. Accordingly, the proposed combination of Segre and Cheng does not disclose or suggest the subject matter of Independent Claim 1. Moreover, Cheng specifically teaches away from higher energy pulses due to safety concerns. Thus, Applicant respectfully submits that the proposed combination is improper. For all the foregoing reasons, Applicant respectfully submits that this rejection should be withdrawn.

Claim 16 was rejected under 35 U.S.C. § 103 as being unpatentable over Segre and Cheng in view of the publication by Kurnit, et al (“Kurnit”). Kurnit was cited as disclosing an InGaAs detector. Kurnit does not otherwise disclose or suggest the subject matter of Independent Claim 1 lacked by the proposed combination of Segre and Cheng, as discussed above. Applicant therefore respectfully submits that Claim 16 is patentable as depending from a patentable base claim.

Claims 2-3, 8-9, 11-12 and 23 were rejected under 35 U.S.C. 103(a) as being unpatentable over Segre in view of Kurnit. In this regard, the Examiner cites Kurnit as disclosing various technology related to a Raman shifter, a beam compressor, a beam expander and a beam filter. As noted above, Segre does not disclose the subject matter of Independent Claim 1, and Kurnit does not provide the disclosure lacked by Segre in this regard. Applicant therefore respectfully submits that the noted Claims are patentable over the proposed combination of Segre and Kurnit. In any event, Applicant respectfully submits that the proposed combination is improper, for example, because it is unclear why the source system of Kurnit would be desirable in the ceilometer application of Segre. For all of the foregoing reasons, Applicant respectfully submits that this rejection should be withdrawn.

The Examiner rejected Claim 4 under 35 U.S.C. z§ 103(a) as being unpatentable over Segre in view of Kurnit and further in view of U.S. Patent No. 5,058,117 Shoshan, et al (“Shoshan”). Shoshan is cited as disclosing a Raman shifter including at least one internal reflectance element. Shoshan does not otherwise disclose the subject matter of Independent Claim 1 lacked by the proposed combination of Segre and Kurnit. Accordingly, even assuming *arguendo* that the new combination proposed by the Examiner is proper, the proposed combination does not yield the subject matter of Claim 4, and this rejection should therefore be withdrawn.

Claim 5 was rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of Kurnit. As discussed above, Independent Claim 1 is patentable over the proposed combination of Segre and Kurnit, and Claim 5 is therefore allowable as depending from an allowable base Claim.

Claims 6 and 7 were rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of Kurnit and further in view of U.S. Patent No. 4,858,238 by Cardimona (“Cardimona”). Cardimona is cited as disclosing a seed laser for use with a Raman shifter. As noted above, the proposed combination of Segre and Kurnit do not disclose the subject matter of Independent Claim 1. Cardimona does not disclose the subject matter lacked by Segre and Kurnit in this regard. Accordingly, Applicant respectfully submits that the proposed combination of Segre, Kurnit and Cardimona does not yield the subject matter of Claims 6 and 7, and this rejection should be withdrawn.

Claim 10 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Segre in view of Kurnit and further in view of U.S. Patent No. 5,414,723 by Krapchev (“Krapchev”). Krapchev is cited as disclosing the use of a pump outside of a housing to circulate an active medium. Again, as discussed above, Segre and Kurnit do not disclose or suggest the subject matter of Independent Claim 1. Krapchev does not disclose the subject matter lacked by the proposed combination of Segre and Kurnit in this regard. Accordingly, Applicant respectfully submits that Claim 10 is patentable over the proposed combination of Segre, Kurnit and Krapchev, and this rejection should therefore be withdrawn.

Claims 19 and 20 were rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of a publication of Schwartz Electro-Optics (SEO). SEO is disclosed as teaching a beam steering mirror to steer a beam towards a target. As discussed above, Segre does not disclose this subject matter of Independent Claim 1. SEO does not disclose the subject matter lacked by Segre in this regard. Moreover, as noted above, Segre is directed to a ceilometer and includes no discussion of steering a beam. Accordingly, it is unclear why one would be motivated to combine the teachings of Segre and SEO as the Examiner has suggested, other than by improperly using the present disclosure as a blueprint. Applicant therefore respectfully submits that this rejection should be withdrawn.

Claim 22 is rejected under 35 U.S.C. § 103 as being unpatentable over Segre in view of U.S. Patent No. 6,580,732 by Guch, Jr. et al (“Guch”). Guch is cited as disclosing a system using a high pulse repetition frequency. Applicant respectfully submits that the proposed combination of Segre

and Guch, even if proper, does not disclose or suggest the subject matter of Independent Claim 1. Accordingly, Claim 22 is believed to be patentable as dependent from a patentable base Claim.

Finally, the Examiner rejected various Claims as being under the doctrine of obviousness type double-patenting in view of co-pending Application No. 11/291,505 in various combinations with other publications. Applicant is submitting herewith a terminal disclaimer believed to address all of these obviousness type double-patenting rejections. It is therefore believed that all of these rejections should be withdrawn.

Based upon the foregoing, Applicants believe that all pending claims are in condition for allowance and such disposition is respectfully requested. In the event that a telephone conversation would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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